US009162841B2

(12) **United States Patent**
Dunham et al.

(10) **Patent No.: US 9,162,841 B2**

(45) **Date of Patent: Oct. 20, 2015**

(54) **METHOD AND APPARATUS FOR COMBINING ONE OR MORE OF TAMPING A STACK OF SUBSTRATES, LATERALLY OFFSETTING A SUBSTRATE, AND ACTUATING OTHER MECHANISMS USEFUL IN PRINTING IN AN IMAGE FORMING DEVICE**

(71) Applicant: **XEROX Corporation**, Norwalk, CT (US)

(72) Inventors: **Brian J. Dunham**, Webster, NY (US); **Carlos Manuel Terrero**, Ontario, NY (US)

(73) Assignee: **Xerox Corporation**, Norwalk, CT (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 218 days.

(21) Appl. No.: **13/927,059**

(22) Filed: **Jun. 25, 2013**

(65) **Prior Publication Data**

US 2014/0373781 A1 Dec. 25, 2014

(51) **Int. Cl.**

B65H 31/20	(2006.01)
B65H 31/26	(2006.01)
B65H 31/34	(2006.01)
B65H 31/38	(2006.01)
B65H 33/08	(2006.01)

(52) **U.S. Cl.**

CPC ***B65H 31/20*** (2013.01); ***B65H 31/26*** (2013.01); ***B65H 31/34*** (2013.01); ***B65H 31/38*** (2013.01); ***B65H 33/08*** (2013.01); *B65H 2301/4219* (2013.01); *B65H 2301/4222* (2013.01)

(58) **Field of Classification Search**

CPC B65H 31/20; B65H 31/26; B65H 31/34; B65H 31/38; B65H 33/08; B65H 2301/421; B65H 2301/4219; B65H 2301/4222

USPC 271/220, 221; 414/788.9, 789.1, 791.2

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,951,264	A *	4/1976	Heidecker et al.	206/308.3
2009/0236798	A1*	9/2009	Kimura et al.	271/221
2010/0044958	A1*	2/2010	Tomida	271/234
2012/0299239	A1*	11/2012	Wang et al.	271/227
2013/0285313	A1*	10/2013	Iwata	271/220

* cited by examiner

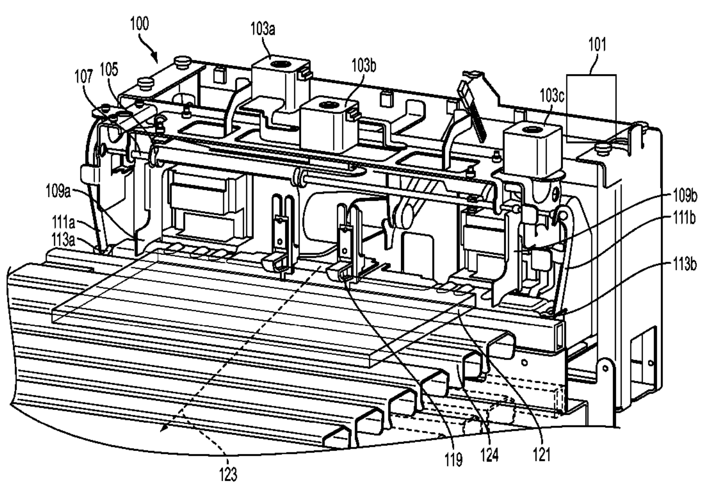
Primary Examiner — David H Bollinger

(74) *Attorney, Agent, or Firm* — Ronald E. Prass, Jr.; Prass LLP

(57) **ABSTRACT**

An approach is provided to cause an operation comprising one or more of a substrate tamping process, a substrate offset process, and a mechanism actuation process. The approach involves determining an instruction to cause the operation. The approach also involves causing a movement of one or more of a slide element and a shaft based on the instruction. The slide element and the shaft are configured to move in a first direction and a second direction along a length of the shaft. The movement in the first direction and the second direction of one or more of the slide element and the shaft corresponds to the operation.

16 Claims, 6 Drawing Sheets



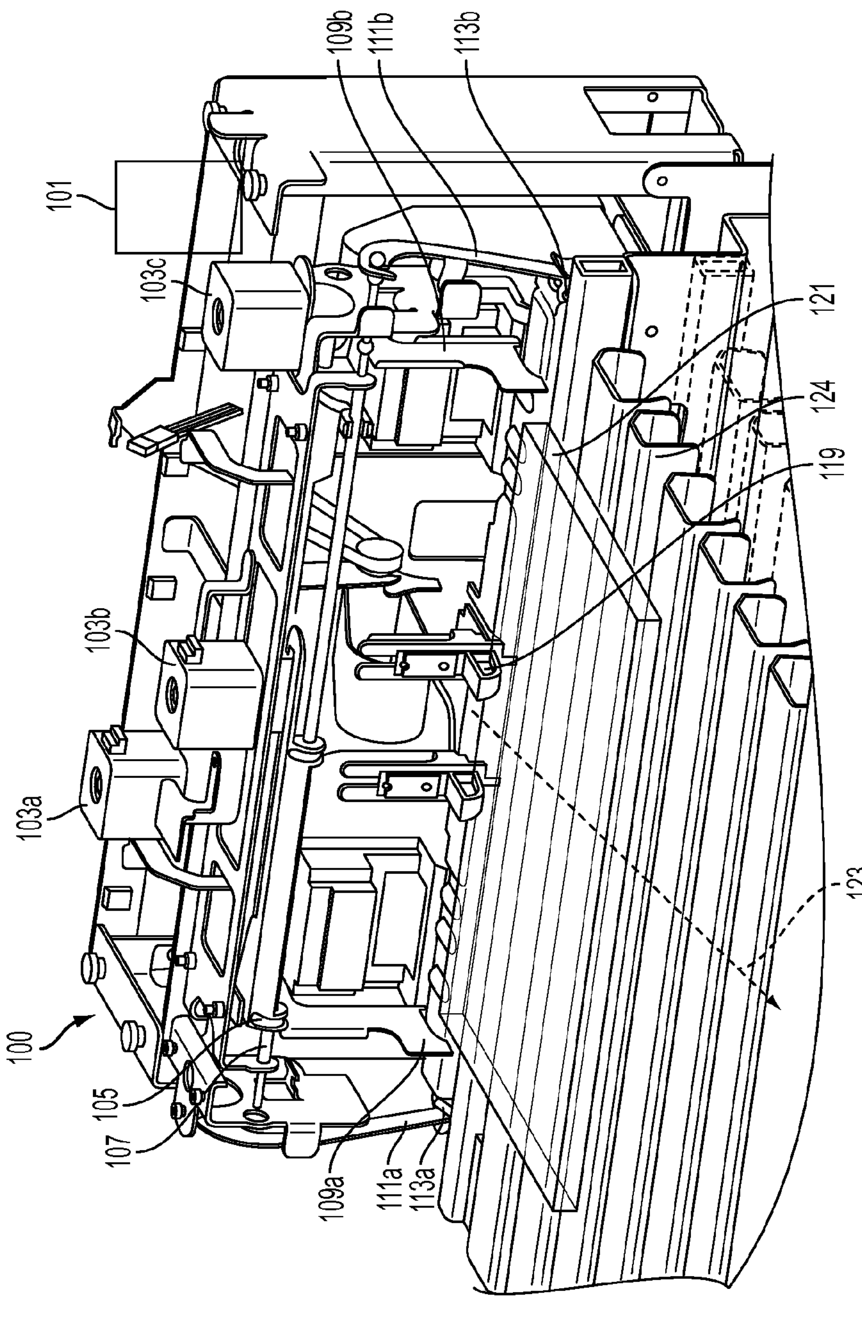

100
101
103a
103b
103c
105
107
109a
109b
111a
111b
113a
113b
119
121
123
124

FIG. 1

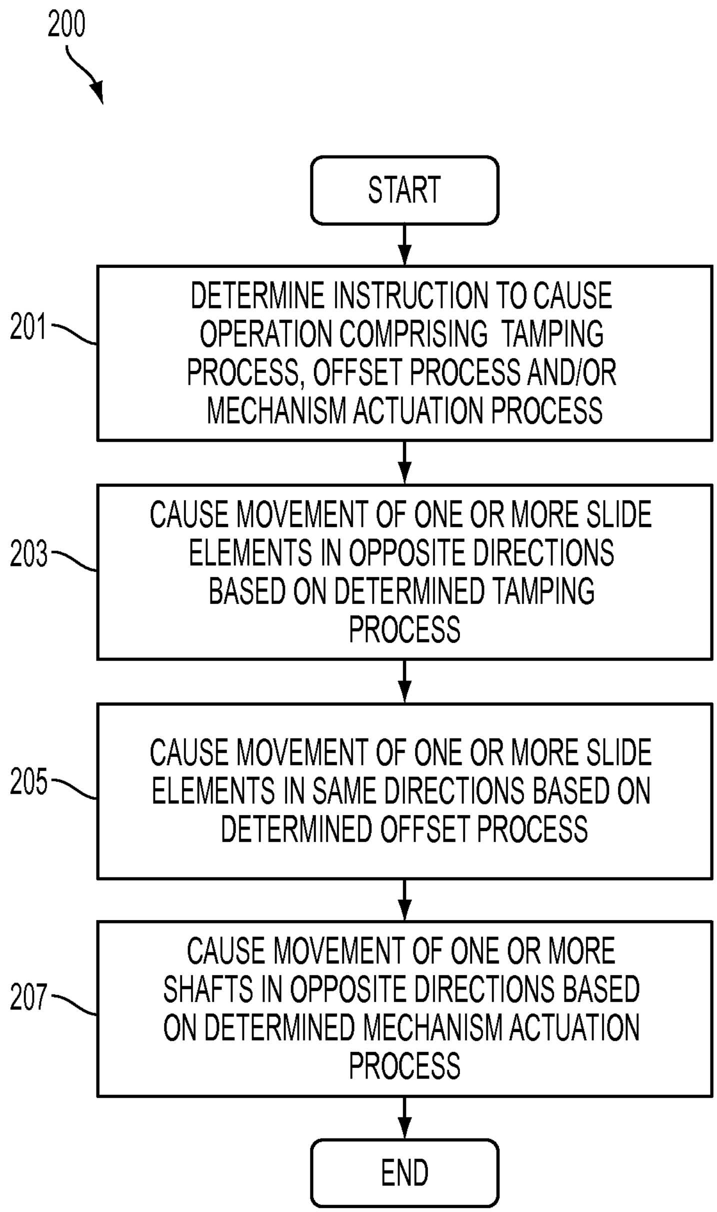

200
START
201
DETERMINE INSTRUCTION TO CAUSE OPERATION COMPRISING TAMPING PROCESS, OFFSET PROCESS AND/OR MECHANISM ACTUATION PROCESS
203
CAUSE MOVEMENT OF ONE OR MORE SLIDE ELEMENTS IN OPPOSITE DIRECTIONS BASED ON DETERMINED TAMPING PROCESS
205
CAUSE MOVEMENT OF ONE OR MORE SLIDE ELEMENTS IN SAME DIRECTIONS BASED ON DETERMINED OFFSET PROCESS
207
CAUSE MOVEMENT OF ONE OR MORE SHAFTS IN OPPOSITE DIRECTIONS BASED ON DETERMINED MECHANISM ACTUATION PROCESS
END

FIG. 2

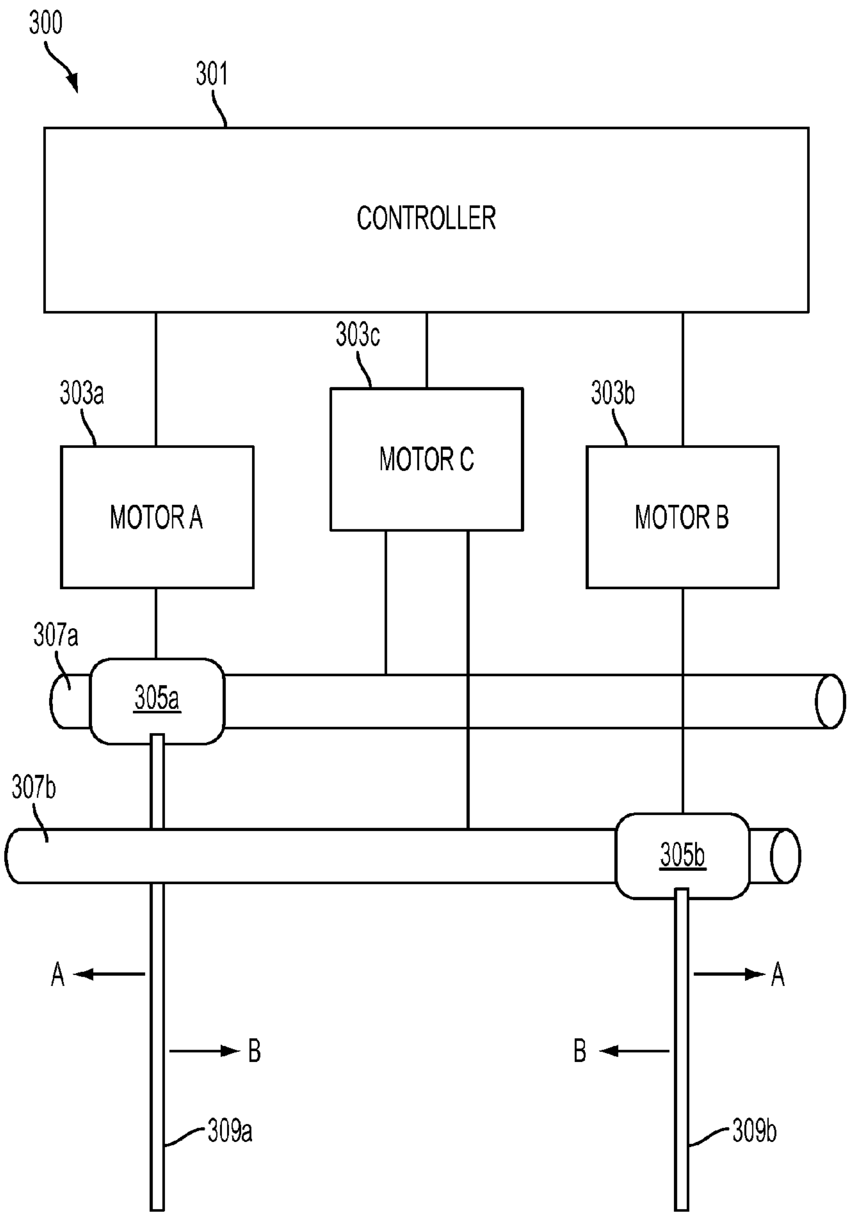

300
301
CONTROLLER
303c
303a
303b
MOTOR C
MOTOR A
MOTOR B
307a
305a
307b
305b
A
A
B
B
309a
309b

FIG. 3

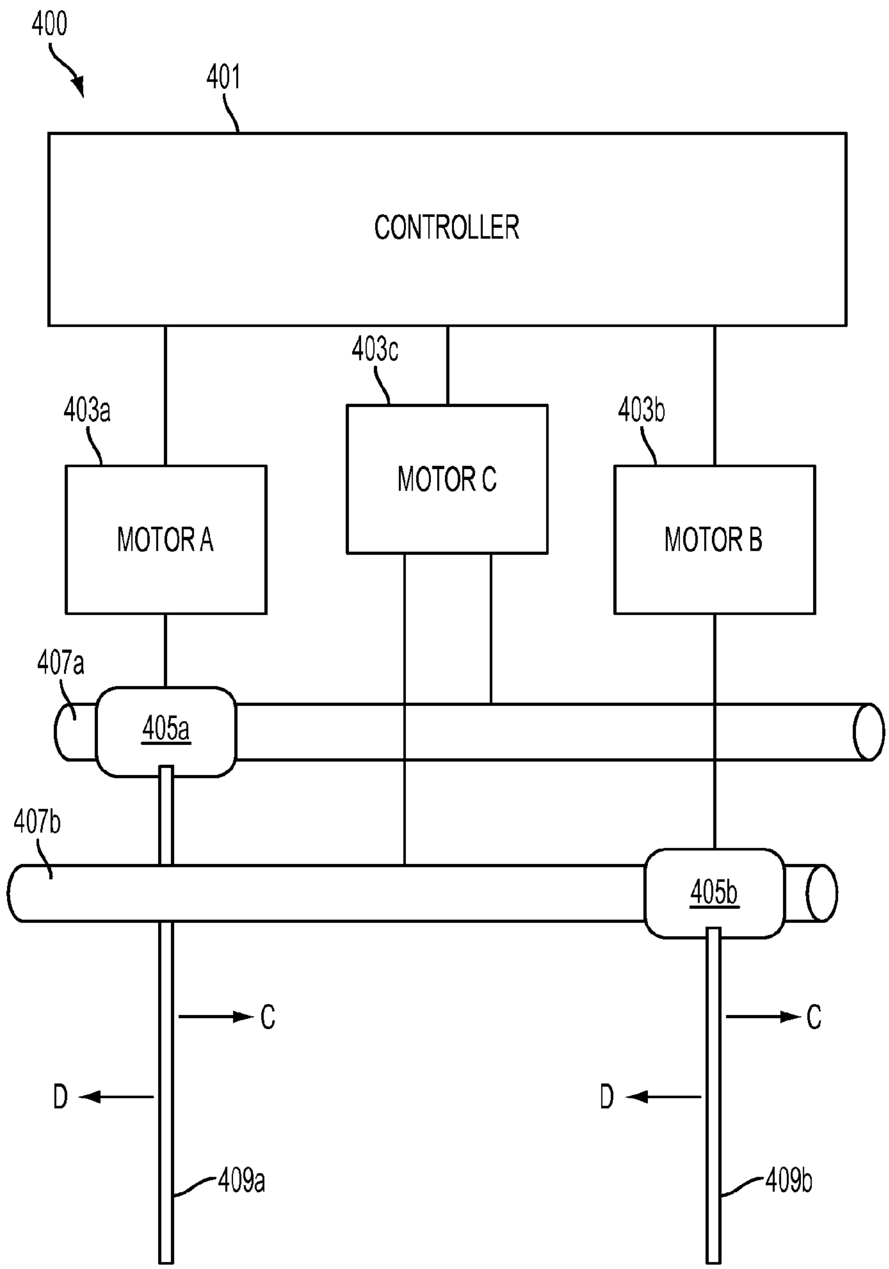

400
401
CONTROLLER
403c
403a
403b
MOTOR C
MOTOR A
MOTOR B
407a
405a
407b
405b
C
C
D
D
409a
409b

FIG. 4

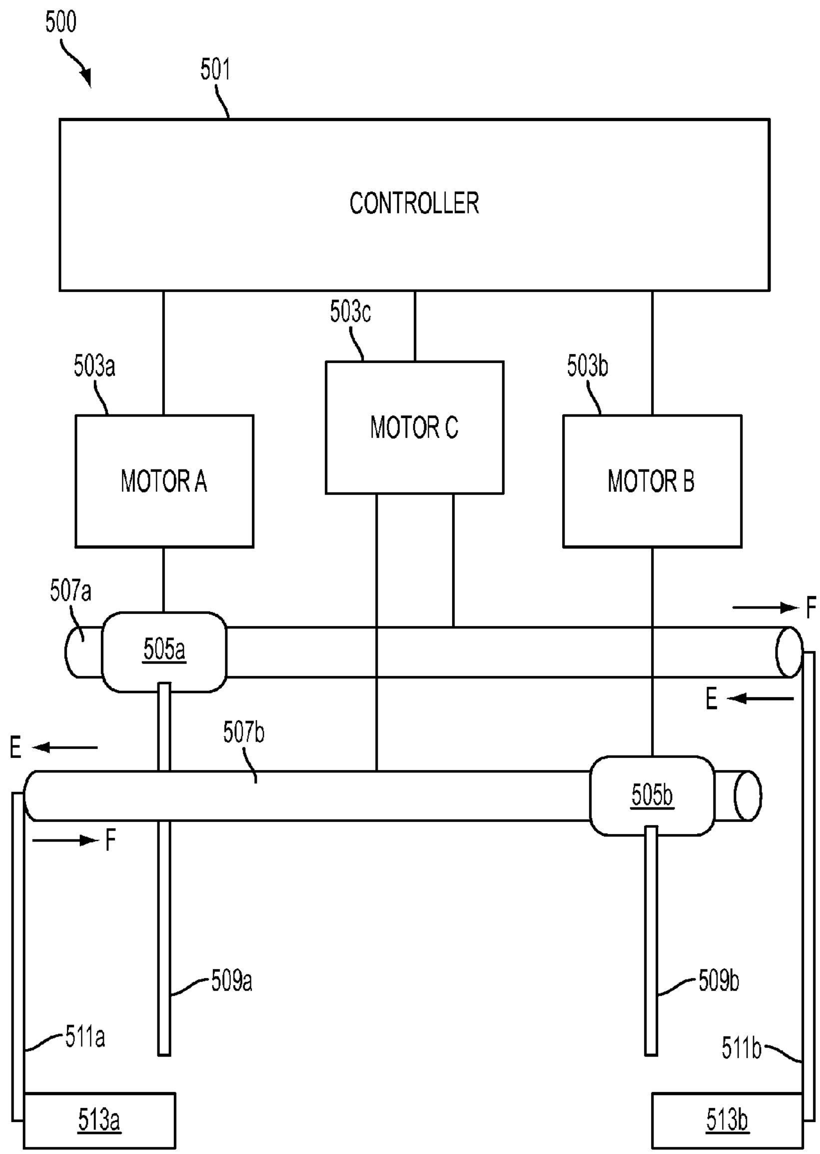

500
501
CONTROLLER
503c
503a
503b
MOTOR A
MOTOR C
MOTOR B
507a
505a
F
E
E
507b
505b
F
509a
509b
511a
511b
513a
513b

FIG. 5

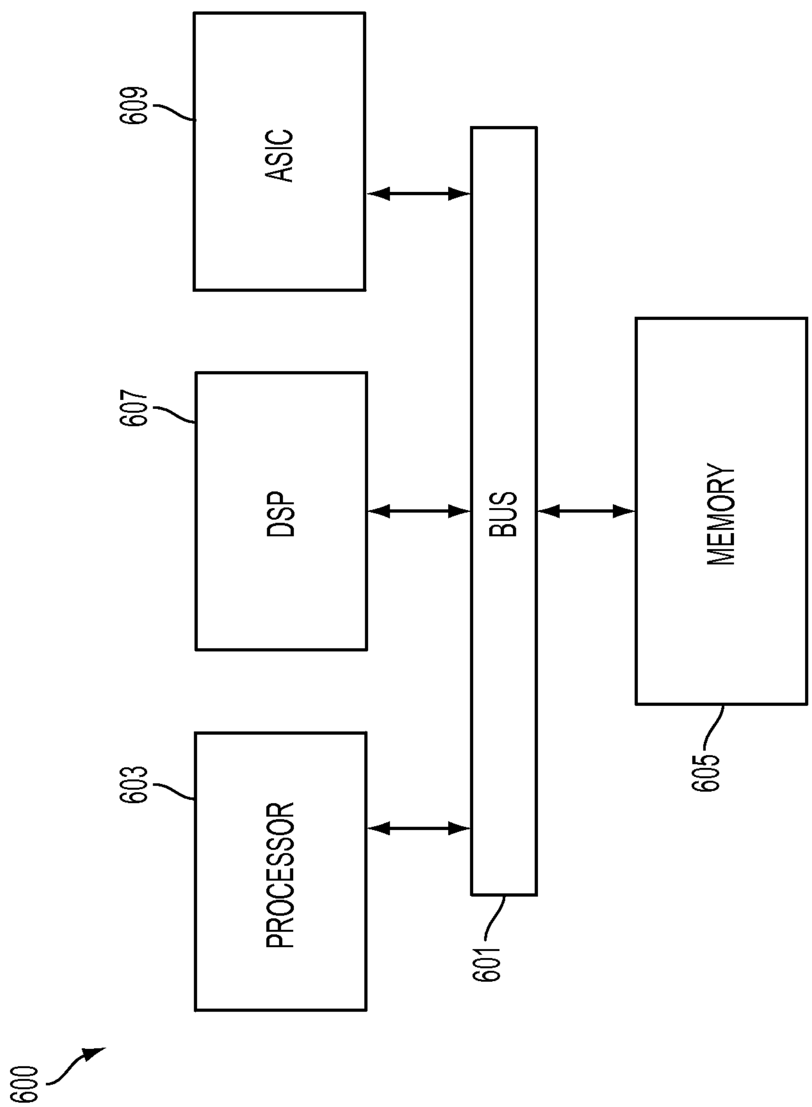


FIG. 6

METHOD AND APPARATUS FOR COMBINING ONE OR MORE OF TAMPING A STACK OF SUBSTRATES, LATERALLY OFFSETTING A SUBSTRATE, AND ACTUATING OTHER MECHANISMS USEFUL IN PRINTING IN AN IMAGE FORMING DEVICE

FIELD OF DISCLOSURE

The disclosure relates to a method and a simplified system to provide a sliding mechanism for implementing a plurality of functions including tamping a stack of substrates, laterally offsetting one or more substrates in a transport path, and actuating other mechanisms that may be useful in controlling the transport of substrates through a transport path in an image forming device.

BACKGROUND

Printing systems in modern image forming devices often provide multiple separate mechanisms that are configured to individually perform tasks associated with, for example, alignment of single and multiple substrates in the image forming devices. These individually-implemented tasks include separate mechanisms for tamping a stack of substrates, for laterally offsetting one or more substrates, and for actuating other mechanisms that are otherwise useful in control of substrate movement through the image forming device. The other mechanisms may include actuating certain latching mechanisms for locking and unlocking components associated with the movement of substrates out of the image forming devices. Image forming device manufacturers are continually challenged to reduce the overall space occupied by various multi-component or multi-function printing systems, without increasing complexity or cost.

SUMMARY

It may be advantageous to provide an approach to implement a simple sliding mechanism that may control a plurality of the functions previously controlled by multiple, and perhaps redundant, components in an image forming device including at least tamping a stack of substrates, laterally offsetting one or more substrates in a transport path, and actuating another mechanism useful in substrate transport in support of printing in the image forming device.

According to one embodiment, a method useful in printing comprises determining an instruction to cause an operation comprising one or more of a substrate tamping process, a substrate offset process, and a mechanism actuation process. The method also comprises causing a movement of one or more of a slide elements and one or more shafts based on the instruction, the slide elements and the shafts being configured to move in a first direction and a second direction along a length of the one or more shafts. The movement in the first direction and the second direction of one or more of the slide elements and the one or more shafts corresponds to the operation.

According to another embodiment, an apparatus useful in printing comprises a physical structure and at least one processor, the processor being programmed to determine an instruction to cause an operation comprising one or more of a substrate tamping process, a substrate offset process, and a mechanism actuation process. The apparatus being configured to promote movement of one or more slide elements and one or more shafts based on the instruction, the one or more slide elements and the one or more shafts being configured to move in a first direction and a second direction along a length of the one or more shafts. The movement in the first direction and the second direction of one or more slide element and the one or more shafts corresponds to the operation.

These and other features, and advantages, of the disclosed systems and methods are described in, or apparent from, the following detailed description of various exemplary embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

Various exemplary embodiments of the disclosed systems and methods for implementing a simplified structure for substrate handling in an image forming device will be described, in detail, with reference to the following drawings, in which:

FIG. **1** illustrates an exemplary overview of the components of a system for combining a plurality of media handling functions, including tamping a stack of substrates, laterally offsetting a substrate, and/or actuating another mechanism useful in printing, according to this disclosure;

FIG. **2** is a flowchart of an exemplary process for combining a plurality of media handling functions, including tamping a stack of substrates, laterally offsetting a substrate, and/or actuating another mechanism useful in printing, according to this disclosure;

FIG. **3** illustrates a schematic diagram of a first exemplary movement of system components for tamping a stack of substrates in an image forming device according to this disclosure;

FIG. **4** illustrates a schematic diagram of a second exemplary movement of system components for laterally offsetting one or more substrates in an image forming device according to this disclosure;

FIG. **5** illustrates a schematic diagram of a third exemplary movement of system components for actuating another mechanism useful in printing in an image forming device according to this disclosure; and

FIG. **6** is an exemplary block diagram of a control system, including a chip set, that can be used to implement a control scheme according to this disclosure.

DETAILED DESCRIPTION

The systems and methods for implementing a simplified structure for substrate handling in an image forming device will generally refer to this specific utility or function for those systems and methods. Exemplary embodiments described and depicted in this disclosure should not be interpreted as being specifically limited to any particular configuration of the described elements, or as being specifically directed to any particular combination of the disclosed intended uses, including being limited in applicability to any particular functioning or operation of a processing, post-processing or other component device in an image forming system. Any advantageous combination of schemes that may employ a particular structure or scheme for implementing multiple substrate handling functions according to the generally-disclosed concepts are contemplated as being encompassed by this disclosure.

Specific reference to, for example, various configurations of image forming systems and component devices within those systems, including post-processors and/or finishers, as those concepts and related terms are captured and used throughout this disclosure, should not be considered as limiting those concepts or terms to any particular configuration of the respective devices, the system configurations or individual elements. The subject matter of this disclosure is intended to broadly encompass systems, devices, schemes and elements that may involve image forming and finishing operations as those operations would be familiar to those of skill in the art. The disclosed concepts are particularly adapted to selectable image receiving media handling operations in small image forming systems, and multi-function devices, as those concepts are understood by those of skill in the imaging and image forming arts.

The disclosed schemes may particularly address issues that arise in many different forms of reduced size devices in which device manufacturers seek to reduce numbers of redundant or nearly-redundant components in a manner that simplifies component structures leading to reductions in overall component or system size.

Examples of a method, apparatus, and computer program for combining a plurality of media handling functions, including tamping a stack of substrates, laterally offsetting a substrate, and/or actuating another mechanism useful in printing, are disclosed. In the following description, for the purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the particularly-disclosed embodiments. It will be apparent, however, to one skilled in the art that the particularly-disclosed embodiments may be practiced without all of the specific details, or with substantially equivalent arrangements. In instances, well-known structures and devices are shown in block diagram form in order to avoid unnecessarily obscuring the embodiments.

As used in this disclosure, the term "slide element(s)" will generally refer to any mechanical component capable of sliding or being caused to slide along a length of a shaft. For example, such a mechanical component may itself be a bearing, comprise a bearing, or be an apparatus that comprises multiple components that include a bearing, or that may be otherwise slidable along the shaft based on any mechanism that may reduce friction between the slide element and the shaft.

FIG. **1** illustrates an exemplary overview of the components of a system **100** for combining a plurality of media handling functions, including tamping a stack of substrates, laterally offsetting a substrate, and/or actuating another mechanism useful in printing, according to this disclosure. The system **100** may be incorporated into, or attached to an output end of, an image forming system or device, including a post-processing device known as a finisher. The finisher may be configured to deliver single stacked sheets and/or to form a staple on a sheeted substrate comprising any material upon which a printed image may be formed. Conventional image forming systems that are configured to tamp a stack of substrates, laterally offset a substrate, and/or actuate another mechanism are often complex in nature because such conventional systems employ several different, and often redundantly-configured, mechanisms for causing any or each of the tamping, offsetting and/or actuating. The several mechanisms often require additional space within, or around, a conventional printing system, and accordingly increase the overall space occupied by the conventional system, as well as increasing the overall complexity and cost of the conventional printing system.

To address this problem, a system **100** as shown in FIG. **1** introduces the capability to provide multiple functionalities such as tamping a stack of substrates, laterally offsetting one or more substrates, and/or actuating another mechanism in a small envelope by reducing the numbers of mechanisms and of various parts that are conventionally necessary to perform these separate tasks. Accordingly, the system **100** includes an apparatus having a pair of slider shafts (see element **107**) and at least a pair of corresponding slide elements (see element **105**). The slide elements are configured to slide between corresponding first positions and corresponding second positions in opposite directions from one another, or in a same direction as one another, on demand and as directed by instructions from a controller **101** to one or more motors **103***a*, **103***b*, **103***c*. The slide elements may have respectively associated with them individual paddles **109***a*, **109***b* for manipulating substrates translating the relative movement of the slide elements to the substrates.

Additionally, the slide elements may be configured to remain in a corresponding predetermined position, or to move to a corresponding predetermined position, while the slider shafts themselves are moved between their own corresponding first and second positions. In some embodiments, the slider shafts may slide relative to the slide elements, for example, to actuate additional mechanisms **113***a*, **113***b*, such as a baffle latch mechanism, that may accordingly be caused to move between an engaged position and a disengaged position on demand through actuation of one or more of a pair of levers **111***a*, **111***b* for translating shaft movement to the actuators.

In embodiments, the slide elements may be a part of a multi-component apparatus that includes the paddles configured to tamp and/or offset a substrate that is processed by the system **100**. For example, as one or more sheets of substrate material are output by a printing system that forms an image on the substrate, the sheeted substrate may be stacked on an output tray **124**. The stack of sheeted materials is sometimes tamped to tidy the stack, and/or one or more sheets are sometimes caused to be offset from other sheets in the stack or for precise alignment with the stacks. Accordingly, slide elements associated with paddles may be caused to move in-and-out in opposite directions with respect to a centerline of an ejection direction **123** of the substrate from the system **100** to provide tamping to stacked sheets, or if offsetting is enabled, the slide elements associated with the paddles may first be aligned with an incoming sheet position and caused to move in a same direction to the respective incoming sheet location.

For review, in FIG. **1**, the system **100** comprises a controller **101**, motors **103***a*, **103***b*, **103***c* (collectively referred to hereinafter as motors **103**), slide elements (depicted in FIG. **1** as a single slide element **105**), shafts (depicted in FIG. **1** as a single shaft **1070**, paddles **109***a*, **109***b* (collectively referred to hereinafter as paddles **109**), levers **111***a*, **111***b* (collectively referred to hereinafter as levers **111**), actuators **113***a*, **113***b* (collectively referred to hereinafter as actuators **113**), and a tray, depicted in FIG. **1** as an elevator tray **124** movable between, for example, an "UP" position and a "DOWN" position.

According to various embodiments, the system **100**, as discussed above, may be configured to be incorporated into a stapler module (not shown). Alternatively, the system **100** may be attached to an output end ejector **119** of the stapler module. The stapler module may be configured to form a staple on a substrate **121**. The substrate **121** is output by the stapler module at the output end ejector **119** and stacked as additional sheets of substrate **121** are output by the stapler module and fed to the elevator tray **124** in the ejection direction **123** individually or as a stapled stack of sheeted substrate **121**.

In embodiments, the controller **101** determines an instruction to cause an operation comprising a plurality of a substrate tamping process, a substrate offset process, and/or a mechanism actuation process. Accordingly, the controller **101** may actuate one or more of the motors **103** to cause a movement of one or more of the slide element(s) **105** and/or at least one of the shaft(s) **107** based on the instruction. The slide element(s) **105** and the shaft(s) **107** may be configured to move in either of a first direction or a second direction one or the other with respect to each other.

For example, as will be described in detail below with reference to FIGS. **3-5**, a first slide element may be configured to slide along a length of corresponding first shaft, and a second slide element may be configured to slide along a length of corresponding second shaft. Shaft(s) **107** may also be configured to slide in a direction corresponding to their respective lengths in the first direction and the second direction while corresponding slide element(s) **105** either remain in a first position or are slid to a predetermined second position that may correspond to a degree of movement of the shaft(s) **107**, or be an entirely different degree of movement. The first and second directions of movement may be considered to be toward and away from a centreline of the ejection direction **123**, respectively.

The movement in the first direction and the second direction of one or more of the slide element(s) **105** and the shaft(s) **107** corresponds to the instructed operation. For example, if a substrate tamping process is instructed, the controller **101** may cause the slide element(s) **105** to move in opposing directions toward or away from one another. By contrast, if a substrate lateral offset process is instructed, the controller **101** may cause the slide element(s) **105** to move in a same direction in concert with one another. Alternatively, if a mechanism actuation process is instructed, the controller **101** may cause the shaft(s) **107** to move in a direction that may actuate a lever to, in turn, translate a shaft movement in a manner that actuates a mechanism, such as a latching mechanism.

In embodiments, the movement of the shaft(s) **107** discussed above may, in some detail, cause corresponding levers **111***a*, **111***b* to move latches **113***a*, **113***b* between respective engaged and disengaged positions. Such movement of the latches **113***a*, **113***b* may be used, for example, to attach and/or detach the system **100**, in whole or in part from an output tray, a guide member, or a portion of the finisher and/or associated stapler module. In the example shown in FIG. **1**, the levers **111***a*, **111***b* may be hinged such that a movement of one end of the levers **111***a*, **111***b* in the first direction, for example, may cause another end of the levers **111***a*, **111***b* to move in the second direction, and vice versa. It should be noted, however, that the mechanism actuation process should not be limited to requiring the levers **111***a*, **111***b* to move in this manner. Rather, movement of the shaft(s) **107** may be used to cause any form of actuation or movement of another component of the system **100**, finisher or stapler module, for example.

According to various exemplary embodiments, the movement of the slide element(s) **105** and the shaft(s) **107** are further caused by at least one of the motors **103**. For example, a single one of the motors **103** may be configured to control movement of any combination of the slide element(s) **105** and the shaft(s) **107**, as instructed by the controller **101** in any combination of the first direction and the second direction based on the instructed operation. Alternatively, the movement of the slide element(s) **105** and the shaft(s) **107** may be caused by a series of specifically configured ones of the motors **103**, which may be independently designated and/or operated as, for example, a tamping motor **103***a*, an offset motor **103***b*, and an actuator motor **103***c* that correspond to a particular one of the instructed operations.

In embodiments, the tamping motor **103***a* may be configured to cause the slide element(s) **105** to move in the first direction and in the second direction to perform an as-instructed tamping process. If a substrate tamping operation is instructed, the tamping motor **103***a* may cause the slide element(s) **105** to move in the first direction and in the second direction, opposite the first direction. During the tamping process, the slide element(s) **105** may also be moved by the tamping motor **103***a* in the second direction and in the first direction, opposite the second direction. In other words, the slide element(s) **105** are moved back and forth in opposite directions to tamp the stack of substrates **121**.

In embodiments, the offset motor **103***b* may be configured to cause the slide element(s) **105** to move cooperatively in the first direction or separately to move cooperatively in the second direction to perform an instructed substrate offset process. If a substrate offset operation is instructed, the offset motor **103***b* may cause the slide element(s) **105** to move cooperatively and together in the first direction, i.e. in the same direction. In other words, the slide element(s) **105** are moved back and forth in a same direction together to offset the substrate **121**.

In embodiments, the actuator motor **103***c* may be configured to cause the shaft(s) **107** to move in the first direction and in the second direction to perform an instructed mechanism actuation process. If a mechanism actuation operation is instructed, the actuator motor **103***c* causes the shaft(s) **107** to move in the first direction and in the second direction, opposite the first direction. During the mechanism actuation process, the shaft(s) **107** may also be moved by the actuator motor **103***c* in the second direction and in the first direction, opposite the second direction as needed to return the shaft(s) **107** to an initial starting position in which the shaft(s) **107** were before the mechanism actuation process commenced.

According to various embodiments, the slide element(s) **105** may be connected with corresponding paddles **109***a*, **109***b*. As one or more sheets of substrate **121** are output by the printing system, the paddles **109***a*, **109***b* may cause a position of the sheeted substrate **121** to change with respect to the centerline of the ejection direction **123**. Accordingly, if a sheet of substrate **121** is output at the output end ejector **119** of the printing system, the paddles **109***a*, **109***b* may cause the sheet of substrate **121** to be aligned with the centerline of the ejection direction **123**, or offset from the centerline of the ejection direction **123**. Movement of the paddles **109***a*, **109***b* are configured to correspond with the movement of the slide element(s) **105** because, as discussed above, the slide element(s) **105** may be a part of the paddles **109***a*, **109***b* themselves, or one component of a multi-component apparatus that includes one of the paddle(s) **109***a*, **109***b* and a respective one of the slide element(s) **105**.

FIG. **2** is a flowchart of a process for implementing a plurality of the one or more of tamping a stack of substrates, laterally offsetting a substrate, and actuating another mechanism useful in printing. In one embodiment, the controller **101** performs the process **200** implemented in, for example, a chip set including a processor and a memory as shown in FIG. **6**. In step **201**, the controller **101** may determine an instruction to cause an operation comprising one or more of a substrate tamping process, a substrate offset process, and a mechanism actuation process.

Then, in step **203**, the controller **101** may cause a movement of a first slide element and a second slide element in opposite directions based on the instruction, the slide element(s) being configured to move in a first direction and a second direction along lengths of respective shafts. The movement in the first direction and the second direction of the slide element(s) corresponds to the operation. For example, if a tamping process is instructed, the controller **101** may cause the slide element(s) to move in the first direction and in the second direction based on the instructed substrate tamping process. Any movement of the slide element(s) in the instructed substrate tamping process may be caused by one or more motors that may include, for example, a tamping motor or motors.

Next, in step **205**, the controller **101** may cause movement of a slide element and another slide element in a same direction based on the instruction, the slide element(s) being configured to move in a first direction and a second direction along lengths of respective shafts. The movement in the first direction and the second direction of the slide element(s) corresponds to the operation. For example, if an offset process is instructed, the controller **101** may cause the slide element to move in the first direction and the another slide element to also move in the first direction based on the determined substrate offset process. Any movement of the slide element(s) in an offset process may be caused by one or more motors that may include, for example, an offset motor or motors.

The process continues to step **207**, in which the controller **101** may cause a movement of a shaft and of another shaft in opposite directions based on the instruction, the shaft(s) being configured to move in a first direction and a second direction along a respective length of the shaft(s). The movement in the first direction and the second direction of the shaft(s) corresponds to the operation. For example, if a mechanism actuation process is instructed, the controller **101** may cause the shaft to move in the first direction and the another shaft to move in the second direction based on the determined mechanism actuation process. Any movement of the shaft(s) in a mechanism actuation process may be caused by one or more motors that may include, for example, an actuator motor or motors.

In the mechanism actuation process, the controller **101**, by way of moving the shafts, may additionally cause one or more lever(s) configured to interact with one or more of the shaft and the another shaft to move actuator(s), to which the lever(s) may be mechanically or operationally connected, between an engaged and a disengaged position based on at least one of the movement of the shaft and the movement of the another shaft. The actuator(s) may comprise latche(s), as discussed above, which may be configured to move between the engaged and the disengaged position to enable a tray to be attached to, detached from, or moved with respect to a system.

FIG. **3** illustrates a schematic diagram **300** of a first exemplary movement of system components for tamping a stack of substrates according to this disclosure. A numbering scheme will be employed in FIGS. **3-5** that is common to the numbering scheme shown in FIG. **1** in order to facilitate comparison of the details of the schematic diagrams shown in FIGS. **3-5** to the exemplary embodiment of the overall system **100** shown in more detail in FIG. **1**. Specifically, FIG. **3** illustrates a configuration in which a controller **301** sends commands to one or more motors (motor A) **303***a*, (motor B) **303***b* to command movement of the slide elements **305***a*, **305***b* along respective shafts **307***a*, **307***b*, thereby moving the corresponding paddles **309***a*, **309***b* cooperatively in first directions A, or second directions B, respectively in opposition to one another during a tamping process. In this example, the tamping motors **303***a*, **303***b* may cause the slide elements **305***a*, **305***b* to move away from (direction A) or toward (direction B) each other (and the centerline of the ejection direction **123**—see FIG. **1**). Slide elements **305***a*, **305***b* may be caused to move in opposite directions toward and away from the centerline of the ejection direction such that corresponding paddles **309***a*, **309***b* also are made to move toward and away from the centerline of the ejection direction. In this example, the shafts **307***a*, **307***b* may be held substantially stationary according to a fixed structure of the overall system or may otherwise be held substantially stationary with respect to the slide elements **305***a*, **305***b* based on instructions from the controller **301** to a shaft motor (motor C) **303***c*.

It should be understood that, although depicted as multiple motors **303***a*, **303***b*, respectively controlling the movement of multiple slide elements **305***a*, **305***b*, along respective multiple shafts **307***a*, **307***b*, with their respective paddles **309***a*, **309***b* to accomplish tamping of a stack of substrates under control of the controller **301**, other configurations may be employed. For example, a single motor may control the movement of slide elements **305***a*, **305***b* along the respective shafts **307***a*, **307***b*. Separately or additionally, both of the slide elements **305***a*, **305***b* may be mounted on a single shaft and move with respect one another along that single shaft.

FIG. **4** illustrates a schematic diagram **400** of a second exemplary movement of system components for laterally offsetting one or more substrates according to this disclosure. Specifically, FIG. **4** illustrates a configuration in which a controller **401** sends commands to one or more motors (motor A) **403***a*, (motor B) **403***b* to command movement of the slide elements **405***a*, **405***b* along respective shafts **407***a*, **407***b*, thereby moving the corresponding paddles **409***a*, **409***b* cooperatively and correspondingly in first directions C, or second directions D, during an offset process. In this example, the offset motors **403***a*, **403***b* may cause the slide elements **405***a*, **405***b* to move cooperatively with each other (and in same directions with respect to the centerline of the ejection direction **123**—see FIG. **1**). Slide elements **405***a*, **405***b* may be caused to move in the same direction during the offset process, such that corresponding paddles **409***a*, **409***b* also move cooperatively with each other so as to cause one or more sheets of substrate, as discussed above, to be laterally offset in a single direction from the centerline of the ejection direction. In this example, the shafts **407***a*, **407***b* may be held substantially stationary according to fixed structural components of the overall system or may otherwise be held substantially stationary with respect to the slide elements **405***a*, **405***b* on instructions from the controller **401** to the shaft motor (motor C) **403***c*.

As noted above with respect to FIG. **3**, it should be understood that, although depicted as multiple motors **403***a*, **403***b*, respectively controlling the movement of multiple slide elements **405***a*, **405***b*, along respective multiple shafts **407***a*, **407***b*, with their respective paddles **409***a*, **409***b* to accomplish lateral offset of substrates under control of the controller **401**, other configurations may be employed. For example, a single motor may control the movement of slide elements **405***a*, **405***b* along the respective shafts **407***a*, **407***b*. Separately or additionally, both of the slide elements **405***a*, **405***b* may be mounted on a single shaft and move in a same direction with respect to one another along that single shaft.

FIG. **5** illustrates a schematic diagram **500** of a third exemplary movement of system components for actuating another mechanism useful in printing according to this disclosure. Specifically, FIG. **5** illustrates a configuration in which a controller **501** sends commands to a shaft motor (motor C) **503***c* to command movement of the shafts **507***a*, **507***b* cooperatively or separately in first directions E or second directions F to drive the corresponding levers **511***a*, **511***b* in a manner so as to translate shaft movement to drive actuators **513***a*, **513***b* during a mechanism actuation process. In this example, the shaft motor **503***c* may cause one or the other or both of the shafts **507***a*, **507***b* to move in a manner that moves the levers **511***a*, **511***b* laterally or around a fulcrum so as to translate movement of the levers **511***a*, **511***b* to the actuators **513***a*, **513***b*. Shafts **507***a*, **507***b* are caused to move in axial directions such that corresponding levers **511***a*, **511***b* may be actuated thereby causing respectively associated actuators **513***a*, **513***b* to move from an engaged position to a disengaged position with, for example, a tray to facilitate attachment and removal of the tray to and from the system **100** on demand. In this example, the slide elements **505***a*, **505***b* and the respective paddles **509***a*, **509***b* may be held substantially stationary with respect to the shafts **507***a*, **507***b* on instructions from the controller **501** to the slide element motors, (motor A) **503***a* and (motor B) **503***b*.

In a similar manner to that noted above with respect to FIGS. **3** and **4**, it should be understood that, although depicted as a single motor **503***c* controlling the movement of multiple shafts **507***a*, **507***b* to accomplish the actuation of multiple actuators **513***a*, **513***b*, via multiple levers **511***a*, **511***b* under control of the controller **501**, other configurations may be employed. For example, multiple motors may control the movement of the respective shafts **507***a*, **507***b*. Separately or additionally, a single shaft may be employed to actuate a single lever and actuator combination or to sequentially activate the pair of lever/actuator combinations. Finally, one or both of the actuators **513***a*, **513***b* may be placed directly in mechanical or operational contact with one or both of the shafts **507***a*, **507***b*, doing away with one or both of intervening levers **511***a*, **511***b*.

The disclosed processes may be advantageously implemented via software, hardware, firmware or a combination of these. For example, the disclosed processes, may be advantageously implemented via processor(s), a Digital Signal Processing (DSP) chip, an Application Specific Integrated Circuit (ASIC), Field Programmable Gate Arrays (FPGAs), and other like devices, components, processors and/or circuits. Such exemplary control and processing elements for performing the described functions are detailed further below.

FIG. **6** is an exemplary block diagram of a control system **600**, which may include, or comprise, a chip set, that can be used to implement a control scheme according to this disclosure. Control system **600** may be programmed to implement control of a plurality of substrate handling functions in an image forming device, including tamping a stack of substrates, laterally offsetting a substrate, and actuating another mechanism useful in printing and may include, for example, a bus **601**, a processor **603**, a memory **605**, a DSP **607** and an ASIC **609** component.

The processor **603** and memory **605** may be incorporated in one or more physical packages (e.g., chips). By way of example, a physical package may include an arrangement of one or more materials, components, and/or wires on a structural assembly (e.g., a baseboard) to provide one or more characteristics such as physical strength, reduction in size, and/or limitation of electrical interaction. It is contemplated that, in certain embodiments, the control system **600** can be implemented in a single chip. It is further contemplated that, in certain embodiments, the control system **600** can be implemented as a single "system on a chip." It is further contemplated that in certain embodiments a separate ASIC may not be used, for example, and that all relevant functions may be performed by a processor or processors. Control system **600**, or a portion thereof, may be programmed to constitute a means for performing the plurality of functions including tamping a stack of substrates, laterally offsetting a substrate, and actuating another mechanism useful in printing.

In embodiments, the control system **600** may include a communication mechanism such as bus **601** for passing information among the components of the control system **600**. Processor **603** may have connectivity to the bus **601** to execute instructions and process information stored in, for example, the memory **605**. The processor **603** may include one or more processing cores with each core being configured to perform independently. A multi-core processor enables multi-processing within a single physical package. Alternatively or in addition, the processor **603** may include one or more microprocessors configured in tandem via the bus **601** to enable independent execution of instructions, pipelining, and multi-threading. The processor **603** may also be accompanied by one or more specialized components such as one or more DSPs **607**, or one or more ASICs **609** to perform certain processing functions and tasks. A DSP **607** typically is configured to process real-world signals (e.g., sound) in real time independently of the processor **603**. Similarly, an ASIC **609** can be configured to perform specialized functions that a more general purpose processor either could not perform, or at least could not easily perform. Other specialized components to aid in performing the described functions may include one or more FPGAs, one or more controllers, and/or one or more other special-purpose computer chips.

In embodiments, the processor (or multiple processors) **603** may perform a set of operations on information as specified by computer program code related to one or more of tamping a stack of substrates, laterally offsetting a substrate, and/or actuating another mechanism useful in printing. The computer program code may be a set of instructions or statements providing instructions for the operation of the processor and/or the computer system to perform specified functions. The code, for example, may be written in a computer programming language that is compiled into a native instruction set of the processor. The code may also be written directly using the native instruction set (e.g., machine language). The set of operations may include bringing information in from the bus **601** and placing information on the bus **601**.

The processor **603** and accompanying components may have connectivity to the memory **605** via the bus **601**. The memory **605** may include one or more of dynamic memory (e.g., RAM, magnetic disk, writable optical disk, or the like) and static memory (e.g., ROM, CD-ROM, or the like) for storing executable instructions that, when executed, perform all or at least some of the disclosed steps to implement one or more of tamping a stack of substrates, laterally offsetting a substrate, and actuating another mechanism useful in printing. The memory **605** also stores the data associated with, or generated by, the execution of the steps.

In embodiments, the memory **605** stores information including processor instructions for one or more of tamping a stack of substrates, laterally offsetting a substrate, and actuating another mechanism useful in printing. Dynamic memory allows stored information to be changed by system **100**. RAM allows a unit of information stored at a location called a memory address to be stored and retrieved independently of information at neighboring addresses. The memory **605** is also used by the processor **603** to store temporary values during execution of processor instructions. The memory **605** may also be a ROM or other static storage device coupled to the bus **601** for storing static information, including instructions, that is not changed by the system **100**. Some memory is composed of volatile storage that loses the stored information when power is lost. The memory **605** may also include at least a non-volatile (persistent) storage portion, such as a magnetic disk, optical disk or flash card, for storing information, including instructions, that persists even when the system **100** is turned off or otherwise loses power.

The term "computer-readable medium" as used in this disclosure refers to any medium that participates in providing information to processor **603**, including instructions for execution. Such a medium may take many forms, including, but not limited to, computer-readable storage media (e.g., non-volatile media, volatile media and the like), and transmission media. Non-volatile media include, for example, optical or magnetic disks. Volatile media include, for example, dynamic memory. Transmission media include, for example, twisted pair cables, coaxial cables, copper wire, fiber optic cables, and carrier waves that travel through space without wires or cables, such as acoustic waves and electromagnetic waves, including radio, optical and infrared waves. Signals include man-made transient variations in amplitude, frequency, phase, polarization or other physical properties transmitted through the transmission media. Common forms of computer-readable media include, for example, a floppy disk, a flexible disk, hard disk, magnetic tape, any other magnetic medium, a CD-ROM, CDRW, DVD, any other optical medium, punch cards, paper tape, optical mark sheets, any other physical medium with patterns of holes or other optically recognizable indicia, a RAM, a PROM, an EPROM, a FLASH-EPROM, an EEPROM, a flash memory, any other memory chip or cartridge, a carrier wave, or any other medium from which a computer can read. The term computer-readable storage medium is used herein to refer to any computer-readable medium except transmission media.

While a number of embodiments and implementations have been described, the disclosure is not so limited. Rather, it covers various obvious modifications and equivalent arrangements, which fall within the purview of the appended claims. Although features of various embodiments are expressed in certain combinations among the claims, it is contemplated that these features can be arranged in any combination and order.

Although the above description may contain specific details, they should not be construed as limiting the claims in any way. Other configurations of the described embodiments of the disclosed systems and methods are part of the scope of this disclosure. It will be appreciated that a variety of the above-disclosed and other features and functions, or alternatives thereof, may be desirably combined into many other different systems or applications. Various presently unforeseen or unanticipated alternatives, modifications, variations, or improvements therein may be subsequently made by those skilled in the art which are also intended to be encompassed by the following claims.

What is claimed is:

1. A method useful in printing comprising:

providing a substrate handling device having:

one or two shafts positioned orthogonally to a substrate ejection direction of the device,

two slide elements for sliding both on the one shaft or one each on the two shafts,

two substrate handling paddles associated one each with the two slide elements,

a plurality of motors for (1) moving two slide elements with respect to the one or two shafts or (2) moving the one or two shafts with respect to the two slide elements, and

a controller for controlling operations of the plurality of motors;

determining, with the controller, an instruction to cause an operation comprising one of a substrate tamping process, a substrate offset process, and a mechanism actuation process, the substrate tamping process including causing movement of the two slide elements with one of the plurality of motors being a tamping motor, the substrate offset process including causing movement of the two slide elements with a second one of the plurality of motors being an offset motor; and

controlling, with the controller, the plurality of motors to cause a movement of one or more of the two slide elements and the one or two shafts based on the instruction, the two slide elements and the one or two shafts being configured to move in a first direction and a second direction along an axial length of the one or two shafts, movement of the one or two shafts being caused to move by a third one of the plurality of motors that is an actuator motor different from the tamping motor and the offset motor,

wherein the movement in the first direction and the second direction of one or more of the two slide elements and the one or two shafts corresponds to the operation.

2. The method of claim **1**, further comprising:

determining, with the controller, that the operation comprises the substrate tamping process; and

controlling, with the controller, at least one of the plurality of motors to cause a first of the two slide elements to move in the first direction and a second of the two slide elements to move in the second direction in opposition to movement of the first of the two slide elements based on the determined substrate tamping process to cause the two paddles to execute the substrate tamping process.

3. The method of claim **1**, further comprising:

determining, with the controller, that the operation comprises the substrate offset process; and

controlling, with the controller, at least one of the plurality of motors to cause a first of the two slide elements to move in the first direction and the a second of the two slide elements to move in the first direction in coordination with movement of the first of the two slide elements based on the determined substrate offset process to cause the two paddles to execute the substrate offset process.

4. The method of claim **1**, further comprising:

determining, with the controller, that the operation comprises the mechanism actuation process; and

controlling, with the controller, the actuator motor to cause the one or two shafts to move in one of the first direction and the second direction based on the determined mechanism actuation process to execute the mechanism actuation process.

5. The method of claim **4**, wherein the providing step includes the substrate handling device further providing at least one actuator movable between an engaged position and a disengaged position, the at least one actuator being in mechanical contact with at least of the one or two shafts, movement of the one or two shafts in one of the first direction and the second direction causing the at least one actuator to be moved between the engaged position and the disengaged position.

6. The method of claim **5**, further comprising controlling, with the controller, the actuator motor to cause the one or two shafts to move in a manner that, in turn, causes the at least one actuator to move between the engaged position and the disengaged position.

7. The method of claim **6**, wherein the providing step provides the mechanical contact with an actuating lever interposed between the one or two shafts and the at least one actuator, movement of the one or two shafts by the at least one motor moving the actuating lever to move the at least one actuator between the engaged position and the disengaged position.

8. The method of claim **7**, further comprising enabling at least one of attachment of a tray to, detachment of the tray from or movement of the tray with respect to, the substrate handling device by the movement of the at least one actuator between the engaged position and the disengaged position.

9. An apparatus useful in printing comprising:

one or two shafts positioned orthogonally to a substrate ejection direction of the apparatus;

two slide elements for sliding both on the one shaft or one each on the two shafts;

two substrate handling paddles associated one each with the two slide elements;

a plurality of motors for (1) moving two slide elements with respect to the one or two shafts or (2) moving the one or two shafts with respect to the two slide elements; and

at least one processor, the at least one processor being programmed to:

determine an instruction to cause an operation comprising one of a substrate tamping process, a substrate offset process, and a mechanism actuation process, the substrate tamping process including causing movement of the two slide elements with one of the plurality of motors being a tamping motor, the substrate oft set process including causing movement of the two slide elements with a second one of the plurality of motors being an offset motor; and

control the plurality of motors to cause a movement of one or more of the two slide elements and the one or two shafts based on the instruction, the two slide elements and the one or two shafts being configured to move in a first direction and a second direction along an axial length of the one or two shafts movement of the one or two shafts being caused to move by a third one of the plurality of motors that is an actuator motor different from the tamping motor and the offset motor,

wherein the movement in the first direction and the second direction of one or more of the two slide elements and the one or two shafts corresponds to the operation.

10. The apparatus of claim **9**, the processor being further programmed to:

determine that the operation comprises the substrate tamping process; and

control at least one of the plurality of motors to cause a first of the two slide elements to move in the first direction and a second of the two slide elements to move in the second direction in opposition to movement of the first of the two slide elements based on the determined substrate tamping process to cause the two paddles to execute the substrate tamping process.

11. The apparatus of claim **9**, the processor being further programmed to:

determine that the operation comprises the substrate offset process; and

control at least one of the plurality of motors to cause a first of the two slide elements to move in the first direction and a second of the two slide elements to move in the first direction in coordination with movement of the first of the two slide elements based on the determined substrate offset process to cause the two paddles to execute the substrate offset process.

12. The apparatus of claim **9**, the processor being further programmed to:

determine that the operation comprises the mechanism actuation process; and

control the actuator motor to cause the one or two shafts to move in one of the first direction and the second direction based on the determined mechanism actuation process to execute the mechanism actuation process.

13. The apparatus of claim **12**, further comprising at least one actuator movable between an engaged position and a disengaged position, the at least one actuator being in mechanical contact with at least one of the one or two shafts, movement of the one or two shafts in one of the first direction and the second direction causing the at least one actuator to be moved between the engaged position and the disengaged position.

14. The apparatus of claim **13**, the processor being further programmed to control the actuator motor to cause the one or two shafts to move in a manner that, in turn, causes the at least one actuator to move between the engaged position and the disengaged position.

15. The apparatus of claim **14**, the apparatus further comprising an actuating lever interposed between the one or two shafts and the at least one actuator, movement of the one or two shafts by the actuator motor moving the actuating lever to move the at least one actuator between the engaged position and the disengaged position.

16. The apparatus of claim **15**, the movement of the at least one actuator between the engaged position and the disengaged position enabling at least one of attachment of a tray to, detachment of the tray from or movement of the tray with respect to, the substrate handling device.

* * * * *